UNIVERSITY OF CALIFORNIA PUBLICATIONS

AMERICAN ARCHAEOLOGY AND ETHNOLOGY

Vol. 2 No. 1

THE EXPLORATION

OF THE

POTTER CREEK CAVE

BY

WILLIAM J. SINCLAIR

BERKELEY

THE UNIVERSITY PRESS

APRIL, 1904

PRICE 40 CENTS

UNIVERSITY OF CALIFORNIA PUBLICATIONS
DEPARTMENT OF ANTHROPOLOGY

The publications issued from the Department of Anthropology of the University of California are sent in exchange for the publications of anthropological societies and museums, and for journals devoted to general anthropology or to archaeology and ethnology. They are also for sale at the prices stated, which include postage or express charges. They consist of three series of octavo volumes, a series of quarto memoirs, and occasional special volumes.

IN LARGE OCTAVO:

GRAECO-ROMAN ARCHAEOLOGY.

Vol. 1. The Tebtunis Papyri, Part I. Edited by Bernard P. Grenfell, Arthur S. Hunt, and J. Gilbart Smyly. Pages 690, Plates 9, 1903 . . . . . Price, $16.00

Vol. 2. The Tebtunis Papyri, Part 2 (in preparation).

EGYPTIAN ARCHAEOLOGY.

Vol. 1. The Hearst Medical Papyrus. Edited by G. A. Reisner and A. M. Lythgoe (in press).

AMERICAN ARCHAEOLOGY AND ETHNOLOGY.

Vol. 1. No. 1. Life and Culture of the Hupa, by Pliny Earle Goddard. Pages 88, Plates 30, September, 1903 . . . Price, $1.25

No. 2. Hupa Texts, by Pliny Earle Goddard. Pages 290, March, 1904. . . . . Price, $3.00

Vol. 2. No. 1. The Exploration of the Potter Creek Cave, by William J. Sinclair. Pages 27, Plates 14, April 1904 . . Price, .40

No. 2. The Languages of the Coast of California, South of San Francisco, by A. L. Kroeber (in press).

IN QUARTO:

ANTHROPOLOGICAL MEMOIRS.

Vol. I. Explorations in Peru, by Max Uhle (in preparation).

No. 1. The Ruins of Moche.

No. 2. Huamachuco, Chincha, Ica.

No. 3. The Inca Buildings of the Valley of Pisco.

SPECIAL VOLUMES:

The Book of the Life of the Ancient Mexicans, containing an account of their rites and superstitions; an anonymous Hispano-American manuscript preserved in the Biblioteca Nazionale Centrale, Florence, Italy. Reproduced in fac-simile, with introduction, translation, and commentary, by Zelia Nuttall.

Part I. Preface, Introduction and 80 Fac-simile plates in colors. 1903.

Part II. Translation and Commentary. (In press).

Price for the two parts $25.00

Address orders for the above to the University Press, Berkeley, California. Exchanges to be addressed to the Department of Anthropology, University of California, Berkeley, California.

F. W. PUTNAM, *Director of Department.*
A. L. KROEBER, *Secretary.*

Interior of the main chamber of Potter Creek Cave. Looking toward the southeast from the top of the earth slope in the northwest end. Drawn from photographs.

UNIVERSITY OF CALIFORNIA PUBLICATIONS

AMERICAN ARCHAEOLOGY AND ETHNOLOGY

VOL 2 NO. 1

THE EXPLORATION

OF THE

POTTER CREEK CAVE

BY

WILLIAM J. SINCLAIR.

CONTENTS.

INTRODUCTION.

The limestone caves of California have only recently received the attention due them as localities which have afforded exceedingly favorable opportunities for the entombment and preservation of the remains of man and of the Quaternary fauna of this coast. Some of the most reliable evidence regarding the existence of man during the Quaternary has been derived from the caves of Europe. North American caves have been largely overlooked,

and it is only rarely that they have been made the subject of special or extended investigation by the anthropologist and the palaeontologist.

The work of cave exploration has been undertaken by the Department of Anthropology of the University of California, as a part of the investigation being carried on with a view to determining the antiquity of man on this coast. It has received the generous support of Mrs. Phoebe A. Hearst and has been conducted under the immediate direction of Professor J. C. Merriam.

The existence of bones in the Potter Creek cave was first discovered in 1878, by Mr. J. A. Richardson, who found there the skull of a large extinct bear afterwards described by Professor Cope as the type of a new species.* Later, Professor Cope in company with Mr. Richardson visited the cave, but Cope did not descend into the chamber where Richardson's discoveries were made, assuming that there was nothing of value remaining.

The cave was rediscovered by Mr. E. L. Furlong of the University of California in July, 1902. Mr. Furlong excavated a part of the deposit on the floor of the main chamber, finding a large number of bones pertaining to extinct species. On Mr. Furlong's return to Berkeley, the exploration was continued by the writer and was completed in the summer of 1903.

The present paper is a report on the exploration of the first of the Californian caves in which excavation has been systematically conducted. It has been thought best to reserve for separate publication the descriptions of new species discovered, and to present here the results of more general interest.

The writer desires to express his obligation to Professor F. W. Putnam, the head of the department, for the privilege of conducting this investigation and to Professor J. C. Merriam who has planned and supervised the work and has furnished the list of cave carnivora. Dr. C. Hart Merriam has generously given of his time in the determination of many of the mammals. The fish remains have been studied by President David Starr Jordan. Professor C. A. Kofoid has undertaken the study of the blind spiders collected in the cave. Mr. E. L. Furlong has furnished valuable information regarding

* *Aretotherium simum*, Am. Nat. XIII., p. 791; XXV., pp. 997–999, Pl. XXI.

Looking east across the McCloud River from Baird. The 240-foot terrace is shown above the river on the right, the 90-foot terrace above the buildings on the left. The pointer indicates the ridge in which the cave lies.

the stratigraphy of that portion of the bone-bearing deposit which he excavated. To Mr. J. S. Diller the writer is indebted for information which has been of great value in studying the topographic development of the region in its relation to the cave.

The results of the exploration were secured by leases kindly given to the University by the controllers of the property, Dr. W. C. Bruson and Mr. D. P. Doak.

DESCRIPTION OF THE CAVE.

The Potter Creek cave is situated in Section 23, Township 34 North, Range 4 West, Mount Diablo Meridian. It derives its name from its location in the high bluff on the north side of Potter Creek. The cave is about one mile southeast of the United States fishery station at Baird, on the McCloud River (Pl. 2). It lies in a belt of Carboniferous limestone (McCloud limestone) at an elevation of 1500 feet above sea level, and about 800 feet above the level of the McCloud, at the mouth of Potter Creek (Pls. 8 and 9).

The system of galleries forming the cave trends in a northwest-southeast direction approximately parallel with the strike of the McCloud limestone. The arched entrance (Pl. 3) communicates with a smaller chamber through which admittance is gained to a narrow passageway. Beyond this point the explorer must depend for light on lamp or candle. Following this passage to the left, it is found to terminate abruptly on the margin of a great pit. Here a convenient stalagmite pillar offers a secure point of attachment for a rope ladder. A vertical descent of forty-two feet affords entrance to a room one hundred and seven feet long, about thirty feet wide at its widest part, with the roof rising about seventy-five feet above the lowest point of the floor (Pl. 1). Both walls of the chamber slope toward the west. The west wall overhangs, and is fringed with numerous massive pendants, some of which are shown in Plate 4.

Forming the floor of this great room were two fan-like deposits of earth and stalagmite-cemented breccia, sloping from opposite ends of the chamber and coalescing at their borders. (Pls. 1, 5, 6, 12, 14). Above the apices of the fans rose almost vertical chimney-like openings.

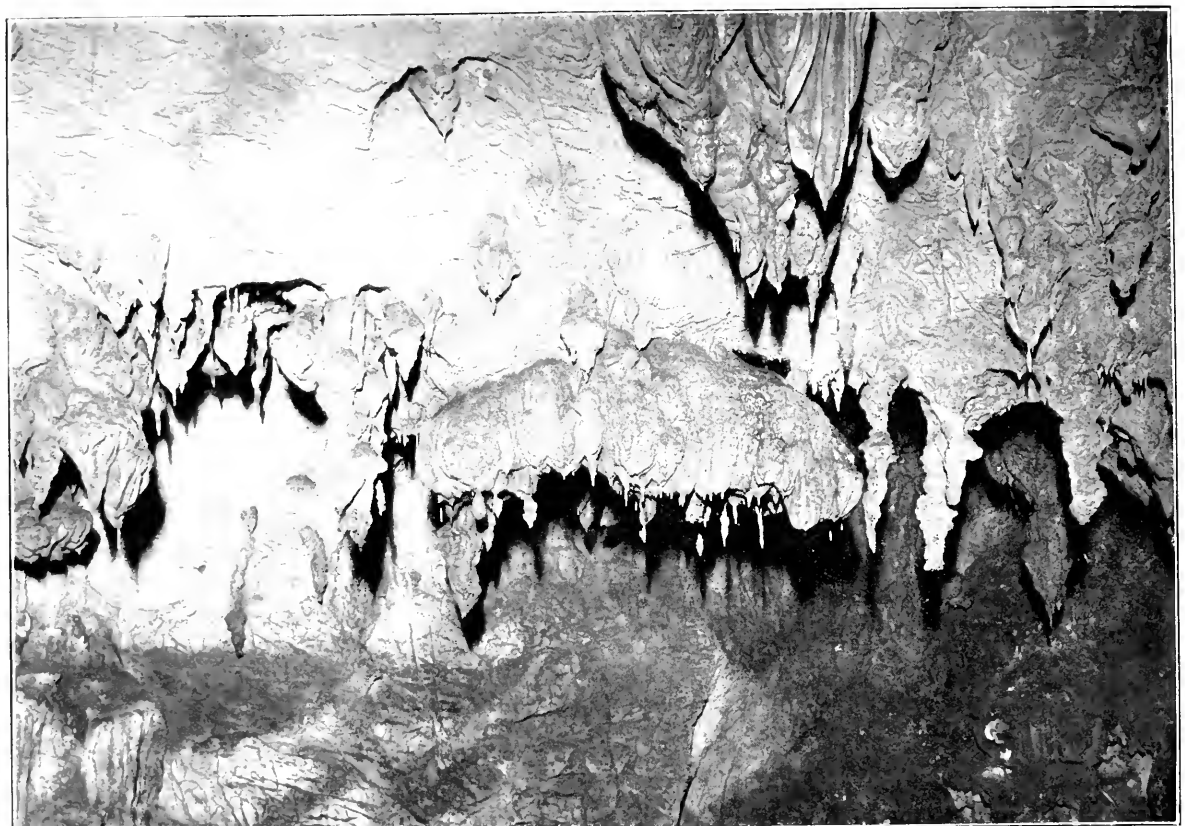
Ascending the chute above the apex of the northwest fan by the rope and ladder shown in Plate 5, a point was reached, forty-one feet above the earth floor, where a small arched cavity communicated with an earth-choked fissure leading toward the surface. Live pine roots were protruding from the clay filling the fissure. On the hillside above, a depression in the limestone, filled with yellow earth and supporting a vigorous growth of brush and one or two young pine trees, may represent the continuation of the fissure toward the surface.

Above the apex of the southeast fan a vertical chimney sub-divides into several openings too small to follow. Leading off from this chimney, a deep pocket-like hole was found, containing a large number of bones imbedded in a highly calcareous earthy matrix. A sheet of stalagmite covered the surface of both fans along the western side of the chamber. Four prominent rock masses rose above the even slope of the floor. The largest of these was in the form of an altar resting upon a base of crystalline stalagmite. Above the altar, a great stalactite hung from the roof (Pls. 1, 6 and 14). Two broad benches of white calcite, rising above the floor, were overlapped by the stalagmite sheet (Pl. 14, Nos. 10, 11). A large fallen block, fringed with pendants and partly imbedded in the surface stalagmite and clay, lay against one of the benches (Pl. 14, No. 8). A record of Mr. Richardson's visit was found on this block, together with the names of several other visitors. Loose blocks of limestone were scattered over the surface of both slopes, especially that in the southeast end. Bat excrement had accumulated over a part of the floor, reaching a depth of a foot and a half along the east wall. It was in the stalagmite floor of this chamber that the bones collected by Mr. Richardson were found.

Method of Working.

Work was begun in the clay about the middle of the main chamber near the margin of the northwest fan, and was carried toward the northwest end. Later, the excavation of the southeast fan was completed. The surfaces of the slopes were staked out in four-foot squares and each of these was worked in ten-inch levels, all the specimens from each section being labeled with the

The cave mouth. The outer chamber mentioned in the text is at the top of the ladder.



Stalactites on the west wall, main chamber.

number of the section and the depth at which they were found. The corner stakes of some of these sections are shown in Plate 6. Much of the material composing the southeast fan was firmly cemented with stalagmite, requiring the use of powder to loosen it, and it was worked by slicing from a vertical face instead of by excavating individual squares horizontally as elsewhere (Pl. 6). Particular attention was given to preventing specimens from a higher level rolling down and becoming confused with bones from a greater depth. The loose earth was sorted with a trowel and removed after each shot. A somewhat similar method was followed in blasting out the lower stalagmite layers. The soft clay beneath was removed and the portions undermined were shot out. The large blocks of cemented clay dislodged by the blasts were carefully broken, and the pieces were examined individually. As excavation advanced the material examined was shoveled back over the worked area.

Stratigraphy of the Northwest Fan.

The structure of the fan in the northwest end was found to be as follows in descending order:

A. Clay with gravel lenses, greatest depth 13½ feet.
B. Persistent gravel stratum, 6 inches to 1½ feet.
C. Volcanic ash, 0 to 1½ feet.
D. Clay with fallen limestone blocks, 0 to 3 feet.
E. Clay and gravel cemented with stalagmite (false floor), 6 inches to 2½ feet.
F. Soft clay, maximum thickness 4 feet.
G. Stalagmite blocks in clay matrix, greatest depth not determined.
H. Stalagmite bosses—cave floor.

The clay of stratum A was similar to the surface soil on the hillside above the cave. It was of a dull yellow color approaching red when wet, and contained abundant angular fragments of blue limestone and occasional pieces of stalactite from the roof. The layer of stalagmite capping the clay on the west margin rarely exceeded a few inches in thickness, usually averaging from half an inch to an inch. It was largely deposited by water dripping from the pendants fringing the west wall.

Within the limits of stratum A were two lenticular sheets of gravel, which terminated abruptly toward the southeast against a large boss of crystalline calcite probably forming part of the original cave floor. (Pl. 12, Sec. 7.) These gravel layers were similar to the larger and more persistent stratum B. All three roughly paralleled the surface of the fan, and thinned out toward the northwest. They were composed of angular, drip-worn fragments of limestone, and seem to have been formed by water falling from the roof and washing the small limestone fragments from the clay. Along the west wall, the gravel strata were in some places found to coincide with sheets of stalagmite. This would indicate that the gravel layers like the stalagmite were formed during halts in the accumulation of the cave deposit. The gravel layers were separated by sheets of clay similar in every respect to the first clay stratum described. On the disappearance of the gravel all these clay strata blend. This is shown in the cross section (Pl. 12), and accounts for the great thickness of stratum A. It is evident from the section (Pl. 12, Sec. 7) that the lower layers of this stratum are older than those above, but it was not possible to separate them beyond the limits of the gravel layers.

The ash layer, stratum C, was composed of fine particles of volcanic glass. It was thin-bedded throughout, indicating deposition in a small pool of standing water. The deposit attained a thickness of a foot and a half toward the center, thinning out at the northwest and southeast margins. The purest samples of the glass are of a pale straw color, and under the microscope appear as fine filaments with vitreous luster. Between crossed nicols they remain dark for all positions of the field. That a part of the ash stratum lying toward the center of the deposit was a deeper ochreous yellow is due, probably, to the presence of limonite leached in from the beds above. The leaching in of lime and iron from the overlying clays has not affected the glass, which is perfectly fresh.

The ash shows little mixture with foreign material, indicating very perfect assorting by the winds which transported it into the cave, and rapid deposition in the pool which then lay on the cave floor. Scattered through the ash there are small black or

Apex of the northwest fan. The vertical chute rises above the ladder.

dark brown grains of doubtful nature, which may represent decomposed rock or mineral particles erupted with the ash.

The stratum lay in general flat, but at the northwest margin it had a dip of about five degrees toward the southeast due to the deposition of the margin of the sheet over the sloping surface of the clay beneath it.

The source of the ash is unknown. It was probably produced by an explosive eruption of some one of the numerous volcanic peaks to the north or east. Apart from the remnant preserved in the cave, no trace of this ash has been found. It must have been deposited widely over the surface of the country, but the thin layer of incoherent material was readily removed during the period of erosion which followed the accumulation of the cave deposit.

Stratum D was similar to the clay composing the upper layers of stratum A, from which it could not be separated beyond the limits of the ash. It contained a considerable number of limestone boulders and was more or less hardened by stalagmitic material.

Excavation ceased during the season of 1902 at the so-called false floor, stratum E, a sheet of cave breccia too hard to penetrate without blasting. The greater part of the floor was removed during the past summer, when it was found to be composed of layers of yellow clay with numerous limestone fragments, the whole cemented by stalagmite into a compact mass.

Lying beneath the false floor was a deposit of soft yellow clay, stratum F, reaching at its maximum a thickness of four feet. The clay was not a constant feature beneath the floor, disappearing toward the southeast, where stratum E rested on bosses of stalagmite.

Stratum G, lying beneath the clay, was composed of large loose blocks of yellow calcite in a clay matrix. Locally the clay was more or less hardened by the infiltration of calcareous material. Filling what appeared to be deep basins in the limestone floor, and occasionally occurring between the loose blocks, was a soft chocolate-colored mud showing stratification planes and evidently deposited in pools of water. The greatest depth of this formation was not determined.

Excavation ceased when great masses of white stalagmite were encountered. These growths did not form a sheet, but were highly irregular, rising as rounded bosses with deep depressions between. They are prolongations of the inward slopes of the cave walls, which are covered with a similar accumulation of stalagmite, and formed the rock floor on which the layers of clay, ash, and gravel were accumulated.

Stratigraphy of Southeast Fan.

The southeast fan was much simpler in structure, possessing none of the variety of stratified deposits found in the middle of the main chamber. The entire deposit in this end of the cave resembled in material and structure the cemented breccia layer, stratum E, of the northwest fan. It was composed of sheets of clay containing a large number of rock fragments of all sizes. Clay and rock were firmly cemented by stalagmite into a hard breccia. Lenses of soft earth occurred, irregularly distributed through the breccia. Often the deposit was quite soft along the cave walls. The soft and hard layers bore no definite relationship to each other either in stratigraphic sequence or areal extent, and frequently passed abruptly from hard to soft. The rocks imbedded in the clay and breccia were either angular masses of blue limestone or more or less rounded calcite bosses similar to the altar base. The calcite bosses seemed to have fallen from above rather than to have formed in place, as the clay was often soft on all sides of them. In the section (Pl. 12) the entire deposit in this end of the cave has been referred to stratum A.

Wherever the rock floor was struck beneath the southeast fan, it was found to be similar to that described for the opposite end of the cave.

Buried Galleries.

During the excavation of the northwest fan there was discovered a series of chambers not before visible. The opening leading to these chambers (Pl. 11, I; Pl. 13, Fig. 5, I) was in the west wall of the main cave and was buried beneath about eleven feet of stratified deposits. The principal gallery had a length of forty-two feet extending parallel with the trend of the main room of the cave. At its northwest end it was prolonged by a low

Apex of the southeast fan. The vertical face developed by blasting is shown beneath the line of stakes in the foreground.

narrow tunnel, eleven feet in length. Joining the main gallery on the west was a semi-circular passage, the floor of which was of blue limestone, but some earth and a few bones had found their way into it.

Flooring the long straight gallery was a mass of cave earth derived from the deposit in the large room. The top of this earth mass represented the continuation of the upper surface of the false floor (Pl. 11). From this point the surface sloped downward steeply toward the northwest. The surface was covered with a creamy white stalagmite varying in thickness from a thin shell up to three or four inches. A small amount of soft earth filled the entrance above the level of the false floor. Within the entrance stratum E could no longer be distinguished, but is probably represented in part by the stalagmite layer. The earth deposit in this tunnel was soft above, but hardened into breccia as the rock floor was approached. Extending at least half way down the slope, beneath the clay, was a sheet of crystalline stalagmite a foot or more in thickness. This was a prolongation of the mass shown at H in Section 5, Plate 13. Beneath the stalagmite the chocolate-colored mud was present to a depth of more than three feet.

Pocket Deposits.

In the east wall of the main cave there is a small tunnel opposite the altar and about twelve feet above the floor. From an entrance of irregular shape it runs downward for about fifteen feet. This hole contained a small amount of earth and a number of rather poorly preserved bones. A much larger tunnel opened from the chute at the southeast end of the cave. This hole was six or seven feet in diameter and descended vertically. It also contained earth and bones which appeared to have found their way in through a narrow vertical opening extending toward the surface. This bone-bearing deposit was worked to a depth of nine feet when the increasing difficulty of handling the excavated material and the want of proper facilities for ventilating the narrow shaft compelled a cessation of the work. The earth in both these pockets was highly calcareous, due to the softening and sloughing off of stalagmitic material covering the walls of

the cavities leading to them. At deeper levels the matrix investing the bones contained more clay. The pockets received their contents in the same manner as the main chamber, but their feeding conduits were smaller and became more readily choked by stalagmitic growths. Several other small cavities in the main cave and leading off from the vestibule were explored, but nothing of value was found in them.

Deposits at the Entrance.

Beneath the limestone arch at the entrance and flooring the passage leading back to the top of the rope ladder, deposits of soft yellow ossiferous earth were found. This material had a depth of over five and a half feet at the entrance, resting on a limestone floor which pitched steeply toward the northwest. In the gallery beyond the entrance the clay occupied shallow basins in the limestone floor. In one of these basins bones and charcoal fragments were found from six to eighteen inches beneath the surface.

Origin of the Cave Deposit.

With the exception of the stalagmitic growths and fallen blocks, the entire cave deposit was brought in through the vertical chutes which are situated above the apices of the alluvial fans, and through other openings which have been more or less completely closed by the formation of calcite growths. These openings still permit the entrance of water after several days of heavy rain.

Excepting the chocolate-colored mud and the volcanic ash, which show every indication of having been laid down in shallow, water-filled basins, the structure of the main deposit is that of alluvial fans over which successive accumulations arranged themselves with reference to the surface slopes, without involving much water as the stratifying agent. The gravel layers, as already suggested, represent halts in the process of accumulation, during which stalagmite sheets began to form in the most favorable places along the west wall. Otherwise there is nothing to indicate the rate of accumulation or to mark the successive surfaces of the fans.

Surface soil was probably added during each wet season, while earthquakes may have detached some of the larger fallen blocks. Aeolian agencies were effective in transporting the fine ash which must have entered the cave through one or more openings of considerable size. Through some of these dry clay and loose rocks probably fell from time to time, adding to the growth of the cave fans.

Character and Mode of Introduction of Organic Remains.

Bones were found in all the strata explored excepting the volcanic ash and the chocolate-colored mud. Part of the skull of an *Arctotherium* and some remains of *Ursus* lay among the loose rocks on the surface of the southeast fan. Additional material was secured from the stalagmite on the surface of the slope in the northwest end.

The majority of the specimens collected are dissociated limb bones, jaws, teeth, and indeterminate fragments. Complete skeletons were not common. Associated parts of the skeletons of a few squirrels and wood-rats, a snake (*Crotalus*), and a bat were found in the gravel layers. In addition to these, several complete limbs of *Arctotherium simum*, with all the elements in their natural positions, were discovered imbedded in soft clay, in the main chamber. Associated with these were various parts of the skeletons of several individuals of this species.

In all cases the bones have lost their organic matter completely, adhering to the moistened fingers like kaolin. Some of them are weather cracked, indicating that they lay for a time on the surface. The decay of bones in the cave is exceptional, but has been noticed at several places, where they were found reduced to a fine yellow powder, Occasionally some of the large limb bones were found broken across, where they had become softened by percolating water and were unable to support the weight of the earth above them. Many of the bones have been gnawed by rodents.

Apart from fragments, over four thousand six hundred determinable specimens were collected. This material requires no preparation except to wash off the adhering clay. The bones are usually white, but often show yellow and faint blue discolora-

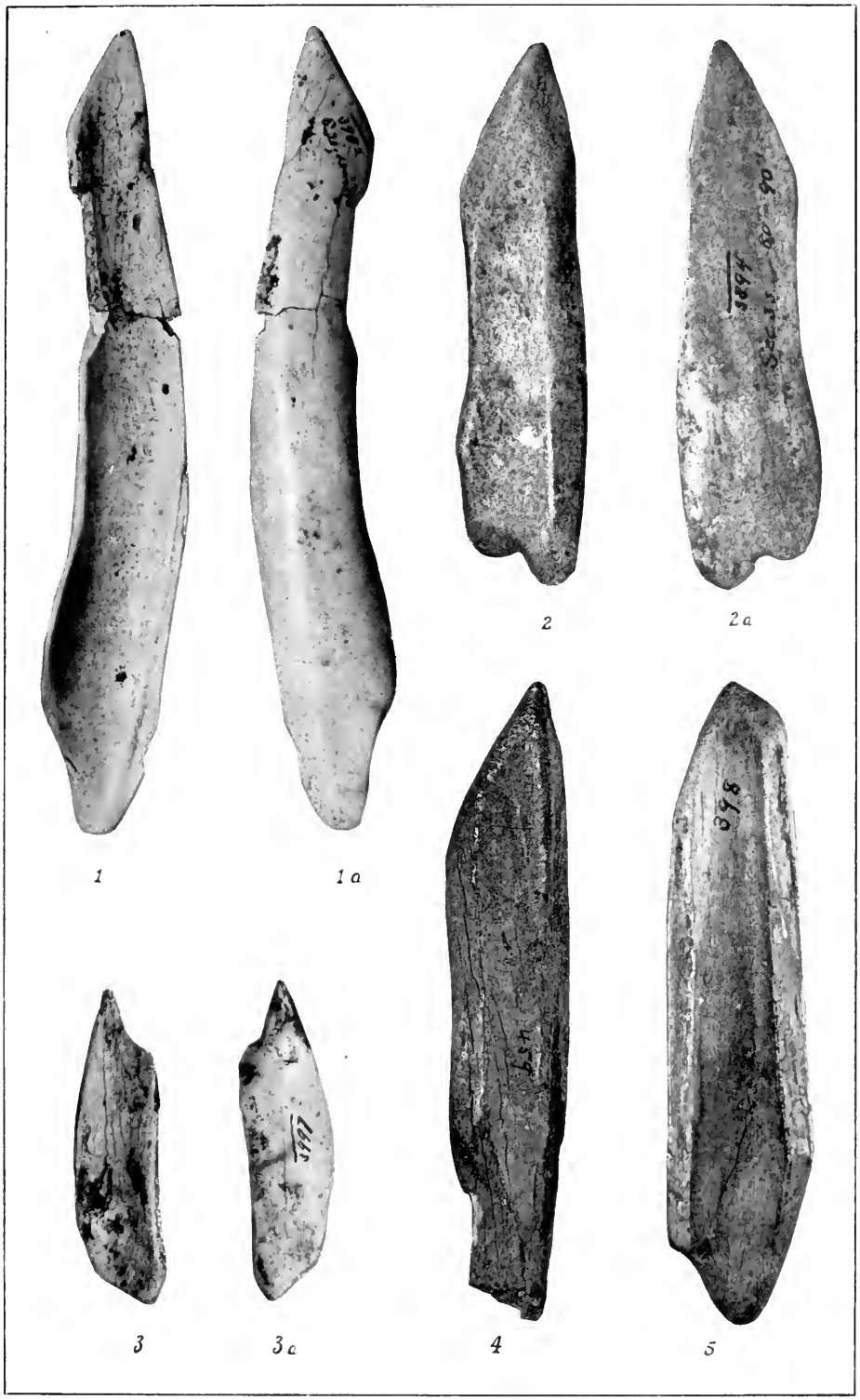
tions. Those from the superficial layers of stratum A are often blackened.

It is difficult to see how such a variety of animal remains could accumulate in the cave, as the number of individuals of the larger forms represented by dissociated parts is considerable. There is little definite evidence indicating that *Arctotherium* lived in any of the existing galleries, and, as it could not easily have climed into the chamber where its remains were found, it is possible that it fell in, but not necessarily by way of the present entrance. There is nothing to indicate that a catastrophic event destroyed large numbers of animals in this vicinity. The cave seems to have remained open for a long time, receiving bones swept in by rills during wet weather, and the remains of such forms as accidentally fell in. It is possible that the *Arctotherium* inhabited a den adjoining the large chamber, and that from this bones found their way into the cave. The edges of some of the larger bone fragments are flaked off in such a manner as to suggest that they might have been broken by the powerful teeth of this great carnivore. No trace of such a den can now be found, owing to later erosion which dissected the surface of the region.

Relics of Possible Human Origin.

Human remains and implements were carefully sought during the whole course of excavation in the Potter Creek cave. During the first season's exploration several polished bones were found which bear a striking resemblance to rude implements. Three typical specimens are represented, natural size, on Plate 7. The largest of these, No. M3982 (Figs. 1, 1*a*) is pointed at both ends, with indications of beveling at one extremity. The whole fragment is polished. The second specimen, No. M3894 (Figs. 2 and 2*a*), has the edges on either side of the point beveled and polished, and shows a distinct notch in the broad end. The remaining edges are rounded and polished. This specimen was found embedded in soft clay between eighty and ninety inches beneath the surface. In an adjacent section several teeth of an extinct ungulate, *Eucratherium collinum*,* were

* See foot-note on p. 18.



Figs. 1–3*a*. Implement like bone fragments from the Potter Creek Cave (Natural size).
Figs. 1, 1*a*, No. 4984, Sec. 20, 130–140 inches beneath surface; Figs. 2, 2*a*, No. 4894, Sec. 33, 80–90 inches beneath surface; Figs. 3, 3*a*, No. 4997, Sec. 7, 80–100 inches beneath surface.
Figs. 4, 5. Bone implements from the Emeryville Shell Mound (Natural size).

found at a level six feet above the implement-like piece of bone The considerable depth at which the specimen was found in undisturbed earth and the presence of remains of an extinct species above it, indicate that it is not of recent origin. The third specimen, No. M3997 (Figs. 3 and 3*a*), is sharply pointed at one end, both surfaces are polished and the edges rounded. These polished bones closely resemble many of the rough implements from the shell mounds of California. Figures of two of these implements, reproduced from the plates accompanying the manuscript of Dr. Max Uhle's report on the exploration of the shell mound at Emeryville, are given on Plate 7, Figures 4 and 5. Dr. Uhle believes that these implements were originally splinters accidentally formed in breaking up long bones. Favorable pieces were selected because they had sharp points and these were polished in use. Often the point has been beveled by rubbing on one side.

To eliminate as far as possible all question regarding the nature and origin of these polished bones, every fragment encountered during the excavation was preserved. These were carefully examined in the laboratory for traces of polish and any indication of cutting or rubbing to form a point or beveled edge. The result has been that a considerable number of specimens were found showing all degrees of polish associated with much variety of form. Some of these fragments bear no relation to any known form of implement and it is not easy to see how they could have been used. Many gradations exist between the irregular polished fragments and the implement-like specimens. This suggests the idea that they have all been made in some other way than through the agency of man, and that the rough, implement-like form is purely a chance occurrence. It is therefore important to inquire whether the wear and polish could have been produced by natural means. In one or two instances polished fragments were found associated with limestone gravel in small rock-rimmed basins, where they had been exposed to the action of dripping water. The association of polished bones with drip-washed gravel suggests that some of the worn bones found in the clay may have been abraded in pot holes by this means, or by rill action, before they were entombed.

While the explanation just given may readily apply to the irregularly-shaped polished fragments, the beveled edges and notched base of the specimen shown in Figure 2 convey a very strong impression of definite purpose controlling its fashioning. On the other hand, the writer does not feel justified in positively asserting the human origin of this relic, believing that we require stronger evidence than it has yet been possible to obtain before such a statement is made.

A large part of the material collected consists of sharp-edged bone splinters. These are found at all depths in the bone-bearing deposits, and in all parts of the cave. Many of the splinters occur low down in the deposits and are associated with remains of numerous extinct animals. They resemble the fractured bones from the shell mounds along the coast. We can conceive of these splinters having been formed in a number of ways. They might have been produced by large bone-crushing carnivores, but well-marked traces of gnawing, excepting those referable to rodents, have not been observed on these fragments. In some cases, bones may have been fractured by the impact of their dropping into the cave, or by heavy stones crushing down upon them, but these explanations can not account for the presence of the large number of sharp-edged splinters found, without having some very definite evidence in their support, and this has been obtained in only a few cases. Fractured bones were found near the entrance in the upper gallery, where the distance from the surface is small. Again, bones may have been broken by striking against the irregular walls of the chutes, through which much of the cave earth entered. Regarding this, it may be said that fragile bones were often recovered entire, while most of the splinters were produced from the fracture of large limb bones. Furthermore, the percentage of abraded specimens is much smaller than would be required by this theory, as most of the splinters still have sharp edges.

Another possible explanation is that they were produced on the surface of the ground outside the cave by the process of weather cracking. Only a few could have been formed in this way, and they would in the majority of cases have the edges rubbed down in the process of being carried into the cave.

Since other suggestions fail to explain the presence of these

splinters satisfactorily, it is not beyond the limits of possibility to suppose that they were made through the agency of man. In the ease of the material from the shell mounds, the bones were broken to extract the marrow by pounding with a heavy stone, resulting in the production of splinters identical in character with those from the cave. A difficult point to explain by this hypothesis is the presence of these fragments in all manner of inaccessible places, as in the pocket in the east wall, where they could not have been thrown, and must have been carried down through narrow rock channels now closed by stalagmitic growths. Possibly they were washed in from a refuse heap or the accumulation in a rock shelter. The uncertainty of the evidence must be advanced in this ease also. At the present time no explanation of the origin of the fragments has been discovered which accords with all the observed facts, though the suggestion that they were made by man appears on the evidence of occurrence to be open to the fewest objections.

In the clay flooring the passage leading back to the top of the swinging ladder, a sharp-edged stone chip, flaked from a river-worn pebble, was found associated with the charcoal mentioned as occurring in the clay. A *Margaritana* shell, several bone fragments, a tooth of the large ungulate, *Eucerotherium*, and a fragment of a mammoth tooth were associated with the stone chip. The charcoal did not occur as a definite stratum, but was scattered in small fragments through a fine clay from six inches to eighteen inches beneath the surface of the floor of the gallery. It seems to have accumulated with clays which were carried in from the surface by rain water percolating through fissures in the limestone. It can hardly be considered as certainly representing a local hearth deposit, though such may be the case. It is also possible that it is the result of Quaternary forest fires and has been washed into the cave.

A careful study of the cave collection has failed to indicate the presence of human bones. Early man might have been in existence in the region and yet his remains have escaped preservation in the cave. Those chambers in which the ossiferous deposit attained its maximum accumulation may not have been easily accessible to man or may have been so far from the entrance

that he would have preferred not to visit them frequently. A fragment of modern Indian basket work was found on the surface near the top of the ladder seen in Plate 3, indicating that the entrance chambers may have been used occasionally in recent years as a place of storage. There was nothing to indicate that they had been so used in prehistoric times. It seems probable that the main chamber of the cave originally had free communication with the surface, serving as a pitfall to catch unwary mammals. The accumulation of human remains in such a pitfall would be of rare occurrence, depending upon accidents against which the superior intelligence of man would protect him.

The cave fauna is not too old to negative the idea of contemporaneity with man. There can be little doubt that if man reached the North American continent during the Quaternary it was by way of the land bridge which then united Alaska with Siberia at Bering Strait. This land connection permitted the migration of many of the mammals now common to the most northern parts of both continents.* It seems reasonable to expect that some of the earliest traces of man in North America would be found on the Pacific coast where the climate was congenial and food supply abundant while the eastern portion of the continent was submerged beneath the ice sheet. Glaciation in California has never been general, occurring only at the higher altitudes. At its maximum the coast was almost as well adapted to human habitation as it is to-day.

The Cave Fauna.

With the exception of bats, no vertebrates are living in the perpetually darkened portion of the cave. A few wood-rats have nested in some of the holes in the cliff above the entrance. Cliff-nesting birds (swallows and wrens) occupy some of the narrow ledges and smaller holes. An occasional rattlesnake may be found in the brush and loose stones about the cave mouth. Several white isopods and a number of spiders were collected in the main chamber of the cave. These were submitted to Professor C. A. Kofoid. The isopods, Professor Kofoid states, are closely allied to *Procellio scaber*, a cosmopolitan species.

*R. Lydekker. "A Geographical History of Mammals," p. 337, pp. 346–348.

The spiders belong to an undetermined species in which external eyes are not apparent. They were living on webs spread in crevices in the cave walls and on the altar in the southeast end. In addition to these, an earthworm and several beetle larvae were found in the damp earth on the floor. A few specimens of a large myriapod were noticed, and encrusted fossil remains of an allied form were occasionally found in the breccia and gravel layers.

The following is a revised† list of the vertebrate species represented by remains collected in various parts of the cave. All extinct species are marked with an asterisk:

**Arctotherium simum* Cope.
**Ursus* n. sp.
**Felis* n. sp.
Felis near *hippolestes* Merriam, C.H.
Lynx fasciatus Rafinesque.
Lynx fasciatus n. subsp. (?)
Urocyon townsendi Merriam, C.H.
Vulpes cascadensis Merriam, C.H.
**Canis indianensis* Leidy.
**Taxidea* n. sp. (?)
Bassariscus raptor Baird.
Mephitis occidentalis Baird.
**Spilogale* n. sp.
Putorius arizonensis Mearns.
Arctomys sp.
Sciurus hudsonicus albolimbatus Allen.
Sciuropterus klamathensis Merriam, C.H.
Spermophilus douglasi Richardson.
Eutamias senex (?) Allen.
Callospermophilus chrysodeirus Merriam, C.H.
Lepus californicus Gray.
Lepus klamathensis Merriam, C.H.
Lepus near *audoboni* Baird.
Lepus sp.
**Teonoma* n. sp.
Neotoma fuscipes Baird.
Microtus californicus Peale.
**Thomomys* n. sp.
Thomomys leucodon Merriam, C.H.
Thomomys monticola Allen.
**Aplodontia major* n. subsp.
Scapanus californicus (?) Ayres.
Antrozous pallidus pacificus Merriam, C.H.

† Provisional list in Science, N.S., Vol. XVII., No. 435, pp. 708–712, May 1, 1903.
* Extinct.

**Platygonus* (?) sp.
Odocoileus sp. a.
Odocoileus sp. b.
Haplocerus montanus Ord.
**Euceratherium collinum* n. gen. and sp.†
**Bison* sp.
*Camelid
**Megalonyx wheatleyi* (?) Cope.
**Megalonyx jeffersonii* (?) Harlan.
**Megalonyx* n. sp.
**Megalonyx* sp.
**Mastodon americanus* Kerr.
**Elephas primigenius* Blumb.
**Equus occidentalis* Leidy.
**Equus pacificus* Leidy.
Crotalus sp.
Mylopharodon conocephalus Baird and Gerard.
Ptychocheilus (?) *grandis* (?) (Ayres).
Acipenser medirostris (?) Ayres.

In addition to the species listed, there should be mentioned a large number of birds which have not been determined, and

* Extinct.

†This form is being investigated jointly by Mr. E. L. Furlong and the writer. The following preliminary description is abstracted from their manuscript:

Euceratherium collinum n. gen. and sp.

Type.—No. M8751 Univ. of Cal. Palaeontological Museum. A cranium without mandible discovered by Mr. E. L. Furlong in the Samwel cave, Shasta Co., Calif.

Generic Characters.—Horn-cores solid, situated far behind orbit, close together on posterior extremity of frontal. Frontal reaching occiput, with large pneumatic cavities extending into bases of horn-cores. Parietal confined to occiput, forming no part of cranial roof. Lachrymal pit broad and shallow. Dental formula $\underline{0}$, $\underline{0}$, $\underline{3}$, $\underline{3}$. Teeth hypsodont, large, without cement or accessory cuspules.

Specific Characters.—Horn-cores laterally compressed and curved, elliptical in cross section at base, circular at tip. Proximal half directed upward and backward, distal half outward and forward. Frontals broadly convex above orbits, slightly inflated toward bases of horn-cores. Occiput with sharp median keel above foramen magnum. Size almost equal to that of *Bos*.

Systematic Position and Relationships.—The new genus is a member of the cavicorn division of Artiodactyla. It combines characters of several groups. From the Bovinae it is separated by the lack of cement and absence of accessory cuspules on the teeth. It differs from the goats in possessing a lachrymal depression. The shape and position of the horn-cores, and the large size of the animal separate it from *Ovis*. It is larger than any of the so-called goat-antelopes of North America, and differs from them in the presence of a lachrymal depression, the conformation of the parietal zone, and the shape and position of the horn-cores. On the other hand, it resembles the Bovinae in size, in the posterior position of the horn-cores, and in the relations of the frontal and parietal, but differs from that group in the possession of a lachrymal pit, and in dental structure. The teeth approximate in size and structure those of *Oribos*, but there are marked cranial differences which separate *Euceratherium* from that genus. E. L. Furlong and Wm. J. Sinclair.

a tortoise. Shells of the helicoid mollusc *Epiphragmophora mormonum* were common, as were also remains of a fresh-water mussel allied to *Margaritana falcata* living in the McCloud river. The fresh-water molluses and the fishes are believed to have been transported by birds.

Of the fifty-two species listed, twenty-one are extinct and two or three in addition doubtfully so.* All the large ungulates and carnivores are extinct, while of the surviving forms the rodents comprise the major portion. Associated with mountain and forest types like *Haplocerus* and the deer are plains species, the horses, camel, bison and elephant. The fauna listed is a unit. No distinction is to be drawn between the collections from the different layers. Several living forms which were not known to date back beyond the recent epoch have been found. Among these may be mentioned the Aplodontidae, the so-called Rocky Mountain goat, *Haplocerus*, and the rattlesnake, *Crotalus*. With the exception of a single individual from Mercer's cave, Calaveras County, ground sloths of the genus *Megalonyx* have been found for the first time in this state, while *Mylodon*, a contemporary of *Megalonyx* in California, is not represented. The types present, as well as the proportion of living to extinct species, indicate that we are dealing with an assemblage of forms of later Quaternary age.

THE CONTEMPORARY FAUNA.

The San Pablo Bay Quaternary.—On the east shore of San Pablo Bay, north of Pinole, there are marine beds resting on the upturned edges of the San Pablo. One stratum is composed largely of oyster shells. Dr. Ralph Arnold has collected from these beds *Ostrea lurida*, *Ostrea conchaphila*, *Mytilus edulis*, and *Tagelus californicus*. On the basis of the character of the strata and their fauna, Dr. Arnold has correlated these beds with the Upper San Pedro series.†

Above the shell beds are alluvial deposits of sand, clay and gravel which have afforded bones of various extinct mammals. Remains of *Elephas* have been found in the shell stratum beneath

*A doubtful sub-species of *Lynx fasciatus*, a *Lepus* and a species of *Odocoileus* may be extinct.

†Memoirs Cal. Acad. Nat. Sci. Vol. III, p. 49.

the alluvium. Including this specimen with the species from the alluvial deposits, the list of vertebrates from this locality is as follows:

Large carnivore genus and sp. indet.
Camelid.
Morotherium gigas Marsh.*
Bison antiquus Leidy.
Elephas primigenius Blumb.
Mastodon americanus Kerr.
Equus pacificus Leidy.
Equus sp.†

This is a plains fauna, and a comparison of it with the cave fauna should be confined to the plains species from the latter, as the bay region during the accumulation of these alluvial deposits was probably not adapted to forest types. With this limitation in mind, the two faunas are seen to be practically the same. From the sequence of Quaternary geological events which Professor Lawson has worked out for the bay region, the beds at Pinole are known to belong probably to the last quarter of that period.‡ This evidence combined with that derived from a study of the mammalian fauna indicates with considerable certainty that they are of the same age as the cave deposit.

The Fauna of the Silver Lake Beds of Oregon.—In order to fix the age of the cave deposit as definitely as possible, comparison may be made with the fossiliferous deposits at Silver Lake in Southern Oregon. The age of these beds is determined by the relation of their mammalian fauna to the faunas characterizing an extensive series of Miocene, Pliocene and Quaternary deposits in the John Day region. The following list of species from this locality is compiled from lists furnished in the manuscript of a paper on the "Fauna of Silver Lake" by Dr. Alice Robertson and from a paper entitled "List of the Pleistocene Fauna from Hay Springs, Nebraska" by Dr. W. D. Matthew.§

Ursus sp. indet.
Felis sp. indet.

* From Tomales Bay and Bull's Head Point, Contra Costa County. Quaternary, same beds as those at Pinole. Merriam, J. C., Bull. G. S. A. Vol. XI, pp. 612–614.

† Smaller than *E. pacificus*, but with more complex tooth pattern than *E. occidentalis*.

‡ Communicated.

§ Bull. Am. Mus. Vol. XVI, pp. 317–322.

Canis latrans Say.
Canis cf. *occidentalis*, Richardson.
Vulpes cf. *pennsylvanicus*, Rhoads.
Lutra canadensis Schreber.
Fiber zibethicus Linnaeus.
Arvicola sp. div.
Thomomys sp.
Geomys sp.
Castor sp.
Castoroides sp.
Lepus sp. (cf. *campestris* Bachman).
Mylodon sodalis Cope (? *M. harlani* Owen).
Equus pacificus Leidy.
Equus n. sp.*
Elephas primigenius? columbi Falconer.
Platygonus, cf. *vetus* Leidy.
Platygonus sp. minor.
Eschatius conidens Cope.
Camelops kansanus Leidy.
Camelops vitakerianus Cope.
Camelops? sp. max.
Antilocapra.

Regarding this association of species Dr. Matthew writes:†

"This is equally a plains fauna, with two aquatic mammals, *Castor* and *Lutra*, not found at Hay Springs. Otherwise the list is very similar to that at Hay Springs, and, like it, is characterized by the absence of the forest types found in the Pleistocene cave deposits, river gravels, and peat bogs of the East."

The list contains several species not found in the cave, among which may be mentioned *Lutra*, *Fiber*, *Geomys*, *Castor*, *Castoroides*, *Antilocapra* and the coyote. Horse, camel and elephant bones make up the greater part of the Silver Lake collections, while the remaining forms are represented by fewer individuals, in some cases by one or two specimens only. In the cave material, there are scores of specimens of *Arctotherium*, *Ursus*, deer, *Euceratherium* and various rodents, while of such plains types as *Elephas*, *Equus* and the camels a few fragmentary teeth were found. *Megalonyx*, which in California seems to have preferred the foot-hill region of the Sierra Nevada and the Klamath Moun-

* Podial elements of an equine very much smaller than *E. pacificus*. The remains are regarded by Dr. Robertson as those of an adult individual.

† loc. cit., p, 321.

tains is replaced in the Oregon plains fauna by the contemporary *Mylodon*.

The Silver Lake fauna is Quaternary and is probably of about the same age as the cave deposit, as the proportion of living to extinct species is practically the same. *Equus pacificus* and *Elephas primigenius* are common to the cave, the beds at Pinole and the Silver Lake locality. Several additional genera are common to the Silver Lake beds and the cave, but there are a number of species, mostly living forms, represented in the Oregon fauna which have not been found in the cave. Some of these differences may be accounted for by the topographic dissimilarity of the two regions and their separation by considerable mountainous areas.

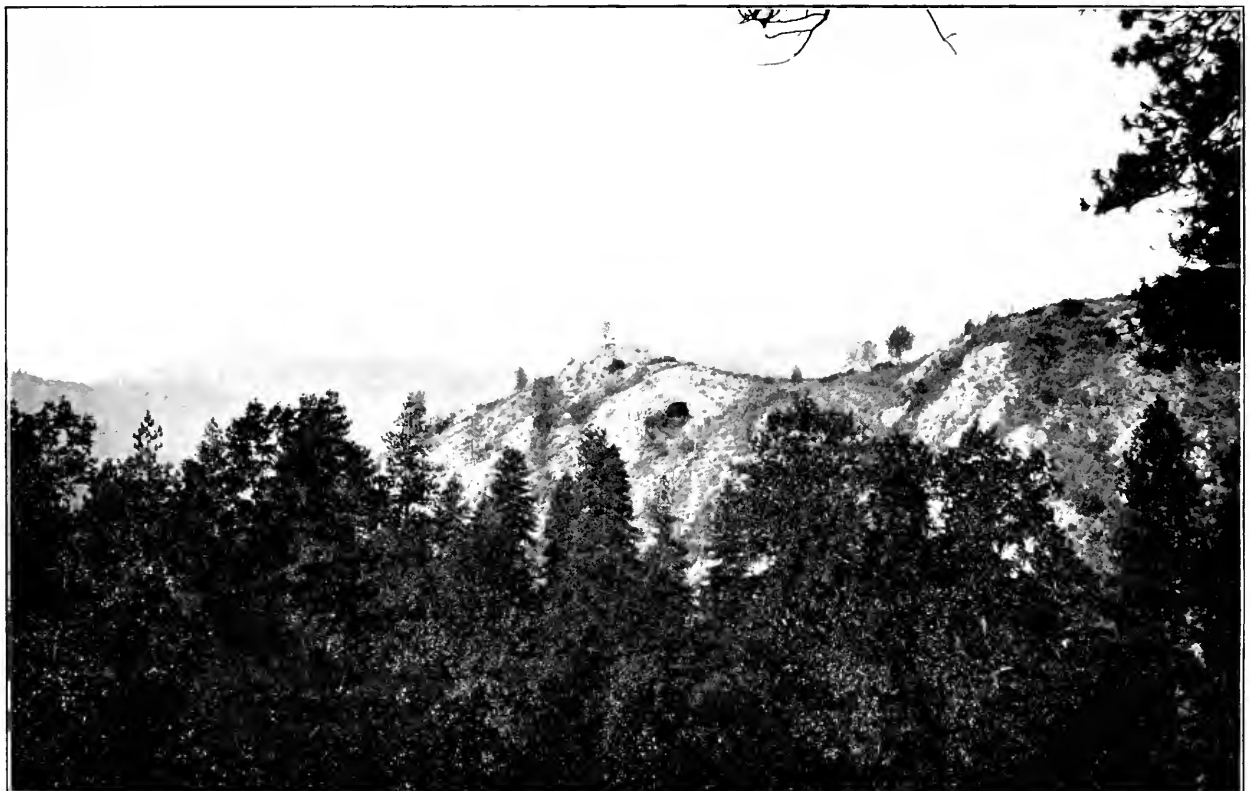
Relation of the Cave to the Existing Topography.

The spur on which the cave lies (Pls. 8 and 9) is one of several westerly and southwesterly trending ridges carved out of the Baird formation and the McCloud limestone, by short streams emptying into the McCloud River. The ridges form divides between cañons with steep slopes. Where they are not controlled by the limestone outcrop, they rise gradually from the 1500-foot contour toward Horse Mountain (4040 ft.). Below the 1500-foot line, the slopes fall off rather abruptly toward the river. The surface from the cave to the mouth of Potter Creek has a fall of 800 feet in about one and one eighth miles.

On the west side of the river, back of Baird, the topography is less rugged. The break below the 1500-foot contour is also better marked (Pl. 10). The stream cañons are fairly deep where they cut through the Baird shales, but broaden out at their head waters on Johns Creek and Turntable Creek.

The creeks coming in from both sides reach the McCloud at the low water level of that stream, but this grade does not extend far up the tributaries, which have a fairly steep slope and are still cutting vigorously.

On both sides of the river water-worn pebbles are abundant up to a level of 1500 feet above sea. These are found on the crests of divides between streams, on cañon slopes and on isolated summits.



Entrance to the cave. Looking northwest across the cañon of Potter Creek.

Looking northeast across the McCloud cañon from the south side of Turntable Creek. The cave lies on the lower limestone ridge indicated by the arrow.

RELATION OF THE CAVE TO THE QUATERNARY TOPOGRAPHY.

The 1500-foot contour marks approximately the present elevation of an earlier valley stage beneath which the existing cañons are trenched. This topographic feature is not particularly well developed in the vicinity of the cave, owing to the excessive amount of stream dissection which the region has suffered. Mr. J. S. Diller has informed the writer that it is well shown in the vicinity of Kennett. It is also developed to the east and northeast of Bear Mountain, and may be viewed to advantage from the high ridge on the south side of Potter Creek. In Plate 10 the trace of this earlier valley surface is shown on the summit of the flat-topped hill in the background. River-worn gravel was found on the top of this hill and also strews the slopes to the back of the terrace shown in the middle ground.

At the time when the cave deposit was accumulating the McCloud River flowed at a level not much lower than the bottom of the cave, or not far below the 1500-foot contour. This level was maintained not only during the time of accumulation, but during the much longer preceding interval required for the removal by solution and otherwise of a mass of limestone equal in volume to the cave. This could not have been accomplished with the river at a higher level, as in that case there would be no exit for the underground water, which would tend to stand in the country rock under pressure rather than to assume a single direction of flow along the fissure line controlling the trend of the cave. The shape of the cave, wide above and narrowing downward, shows that the point of discharge for the percolating waters must have been at a level lower than the present entrance.

As the tributary streams extended back by headwater erosion, the country on either side of the cave was better drained. Less rain water circulated along the fissure and cave cutting ceased, because, instead of draining into the cave by a sink, the water flowed into the creeks. At this stage the large calcite bosses on the floor were formed. Later, openings in the roof, probably formed by rills washing off some of the surface material on the slopes of the incipient cañons of Potter and Marble Creeks, per-

mitted the entrance of clay, rock fragments, broken bones, and possibly living animals.

The mingling of plains and forest types in the Quaternary fauna is in accordance with the known moderate relief of the region, which was a broad valley with wooded hills on either side, above which rose higher peaks like Horse Mountain, affording a congenial habitat to mountain dwelling forms like *Haplocerus*, while the valley land was favorable to the presence of camels and horses.

An eruption from one of the volcanic peaks to the north or east showered the region with fine ash during this stage of topographic development, but this was a mere episode, scarcely an interruption, which did not alter the character of the fauna in the least.

This cycle of low relief was terminated by an uplift, increasing the grade of the master stream, initiating the cutting of the present McCloud cañon, and renewing headwater erosion in the lateral tributaries. Eventually one of these, Potter Creek, cut down through one of the galleries of the cave, opening the present entrance.

With the stripping off of the surface soil from the ridge sides by the deepening creeks, no more clay could enter the cave. The entrance channels were blocked by rocks or crystalline growths and the cave began to seal up its treasures by the formation of a stalagmite sheet, marking the last halt in the process of accumulation.

At first the cañon cutting was rapid, but later the river reached a lower grade and began to meander. A terrace about 240 feet above the present low water stage marks the position of the first halt. This terrace is shown on Plate 2. It is rock-cut with a thin coating of gravel on the surface. The stream gravels scattered on the cañon slopes above this level were left stranded by the McCloud as it cut down from the old 1500-foot base-level.

A second uplift, possibly of a differential character, renewed the downward cutting of the river. A second terrace, also rock-cut but of much greater extent than the first, was formed about 150 to 160 feet above the river at Baird (Pl. 10). The surface of this terrace is strewn with river gravel. A lower and much

West side of McCloud cañon, near Baird, 160-foot terrace in middle ground. The flat-topped hill in the background (elevation 1522 feet) marks the level of the earlier valley stage.

smaller terrace occurs at about ninety feet, and other less distinct levels may be traced to perhaps fifty feet above the river.*

Taking into consideration the amount of cañon cutting accomplished by the McCloud above the 240-foot terrace and comparing it with a similar degree of cutting above a certain terrace level in the cañon of the Sacramento, it seems reasonable to correlate the high terrace at Baird with the broad terrace which is so well developed in the upper end of the Sacramento Valley in the vicinity of Redding. Regarding the age of this terrace Mr. Oscar Hershey† says:

"The Red Bluff formation belongs to the last one-fourth of the Quaternary era. On the northern border of the Sacramento Valley, in Shasta County, there are flats one to two miles wide, consisting of the Red Bluff gravel resting on the truncated edges of the highly inclined metamorphic formations. They are elevated one hundred to two hundred feet above the present streams, as Clear Creek and the Sacramento River, which have trenched narrow cañons below them. The Red Bluff terrace can be traced for several miles up into the mountain valleys of such main streams as those mentioned above, and it is thus made evident that at the very least three-fourths of the erosion of the Sierran valleys had been accomplished by the time of the opening of the Red Bluff epoch."

The amount of erosion in the McCloud cañon above the upper terrace agrees favorably with Mr. Hershey's estimate, and strengthens the correlation of the high river terrace at Baird with the top portion of the Red Bluff formation, spread out over the surface of the Red Bluff terrace in the north end of the Sacramento Valley. About one-quarter of the entire interval of cañon-cutting is represented by the amount of erosion accomplished by the McCloud below the 240-foot terrace level.

The sequence of events which has been made out in the cañon of the McCloud agrees very closely with Professor Lawson's

*The terrace levels given in the writer's preliminary paper (Science N. S., Vol. XVII, No. 435, pp. 708–712) were based on roughly made observations and are not exact. The elevations given here were determined by hand level, distance from the ground to the eye of the observer being taken as a measuring rod. The measurements of the higher terraces were made twice, giving in each case approximately the same result.

†Bull. Dept. Geol. Univ. of Cal., Vol. III, No. 1, p. 12.

presentation of Quaternary history as recorded in the upper Kern basin,* but the cañon of the McCloud is not as deep as that of the Kern, owing to a lesser degree of elevation occasioning the cañon cutting. Professor Lawson's high valley zone corresponds with the earlier valley stage which has been recognized in the vicinity of the cave, beneath which the cañon of the McCloud is trenched. The trenching of the cañon occupied an exceedingly short time compared with the much longer interval required for the development of the old valley surface. The cave fauna occupied the latter during its completed stage, but was not necessarily in existence in the region while this topographic feature was being evolved.

The material excavated by the McCloud while cutting down to the upper terrace level forms a part of the great debris fan buried in the upper end of the Sacramento Valley beneath the Red Bluff terrace.

Older base levels of erosion have not been recognized in the vicinity of the cave owing to the excessive amount of dissection which the region has suffered, but a series of Tertiary peneplains in the Klamath Mountains has been described by Mr. Diller.†

The cave fauna described in the preceding pages is much older than the glacial period in this state. The maximum glaciation of the Sierra Nevada has been referred to the Wisconsin epoch of the glacial time scale worked out for the eastern part of the continent.‡ The Red Bluff epoch which has been correlated with the upper river terrace at Baird, although referable to the last quarter of the Quaternary, is older than the Californian glaciation, from which Hershey has separated it by two epochs of erosion and one of deposition.§

The Fauna in Its Relation to Topographic Changes.

The change from a country of moderate relief to a mountainous district dissected by river cañons reacted on the fauna,

---

*Bulletin Dept. Geol. Univ. of Cal., Vol. III, No. 15, pp. 362–368.

†"Topographic Development of the Klamath Mountains." Bul. 196, U. S. Geological Survey.

‡O. H. Hershey. Bull. Dept. Geol. Univ. of Cal., Vol. 3, No. 1, p. 27. H. W. Turner. Proc. Cal. Acad. Sci., 3rd series, Vol. 1, No. 9, p. 270.

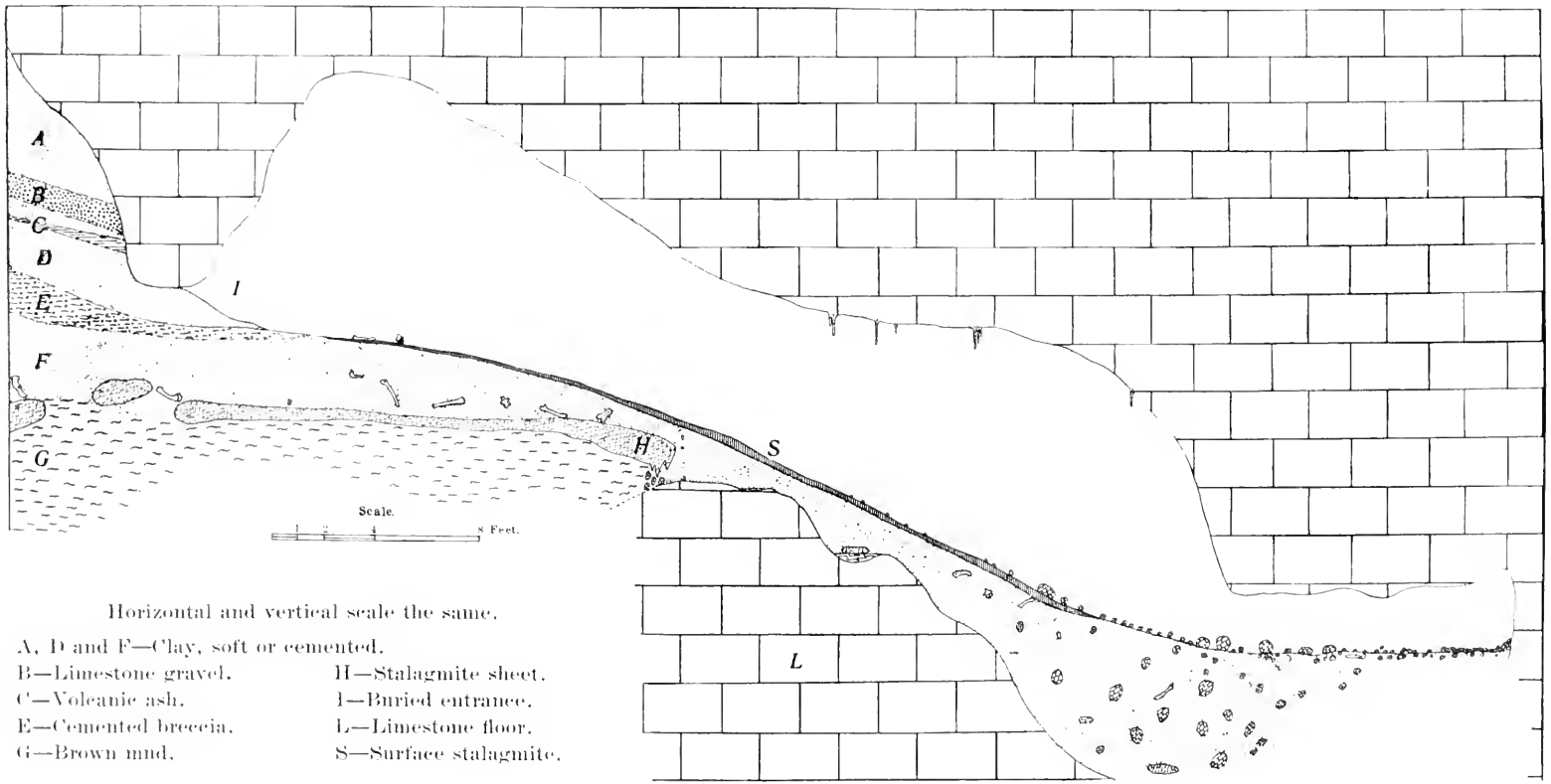
§O. H. Hershey. Bull. Dep. Geol. Univ. of Cal. Vol. 3, No. 1, p. 28

causing migration and extinction. Those species which still exist in the region are the successful survivors, which were able to adapt themselves to the changed conditions. Some of the species which are now extinct may have continued to inhabit the region for a considerable time after the topographic revolution, but this can not be determined until bone-bearing Quaternary deposits of later age have been found. Higher up the McCloud, Mr. Furlong has discovered a cave fauna which is supposed to be younger than that described here. The study of this fauna will, it is believed, throw much light on the problem of faunal migration. The thorough examination of a series of caves ranging in age from early Quaternary to Recent will doubtless furnish valuable evidence relating to the faunal migrations, and should also give most important testimony concerning the time when man first came to inhabit this region.

University of California,
April, 1904.

Explanation of Plate 11.

Longitudinal section of the buried gallery, showing the relation of its deposits to the beds in the main chamber of the cave.



Horizontal and vertical scale the same.

A, D and F—Clay, soft or cemented.
B—Limestone gravel.
C—Volcanic ash.
E—Cemented breccia.
G—Brown mud.
H—Stalagmite sheet.
I—Buried entrance.
L—Limestone floor.
S—Surface stalagmite.

1

2

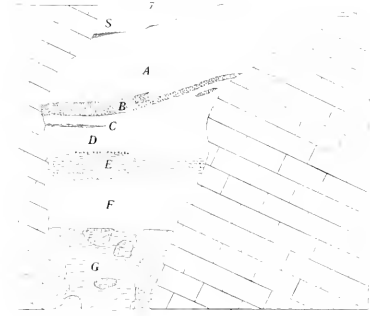
Scale

Fig. [illegible]—Cross sections of the east deposit cuts speaking to small-scale numbered section lines shown on Plates 12 and 14. In each, the east wall lies on the right hand side.

Horizontal and vertical scale the same

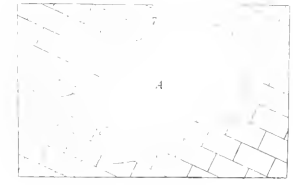
A and F—Clay, soft or semi-solid
B—Stone gravel
C—Grey ash
D—Charcoal layer
E—Brown mud with stalagmite blocks
H—Stalagmite bosses, wave floor
I—Entrance to tunnel gallery
S—Surface stalagmite
7—Line of intersection of longitudinal section (see 7, 12, 14)
9—Altar
11—Rock bench

3

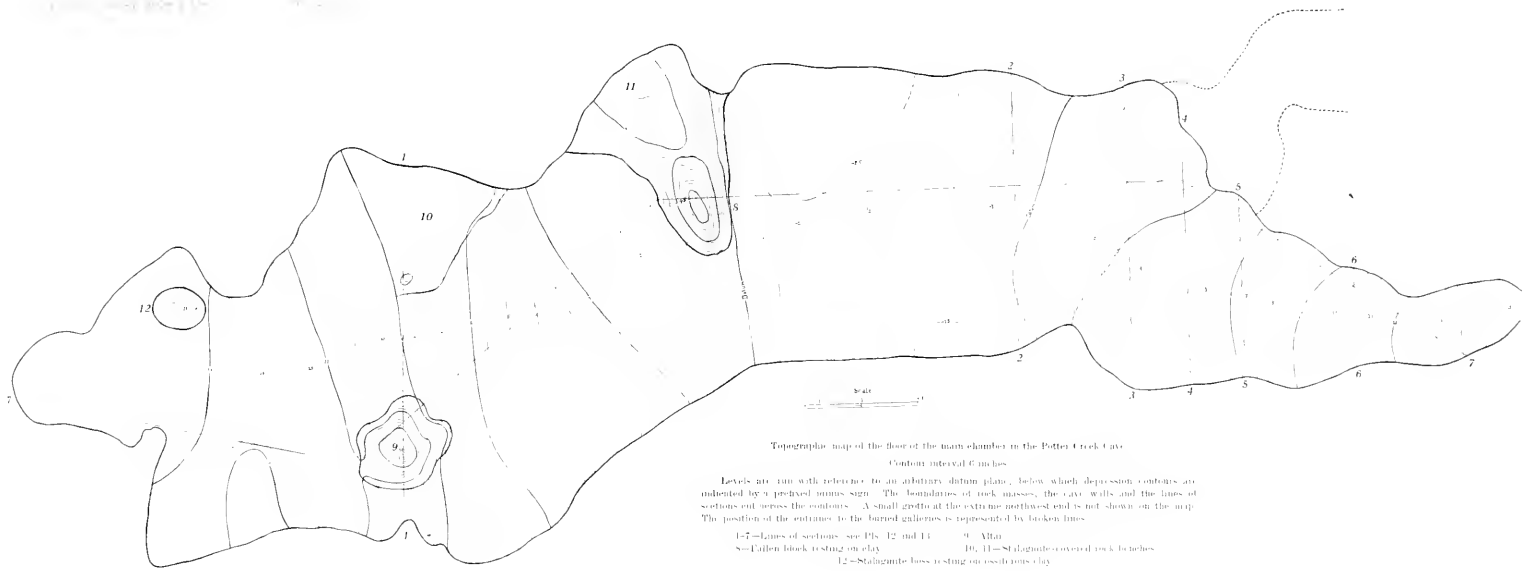


4

5



6



Topographic map of the floor of the main chamber in the Potter Creek Cave

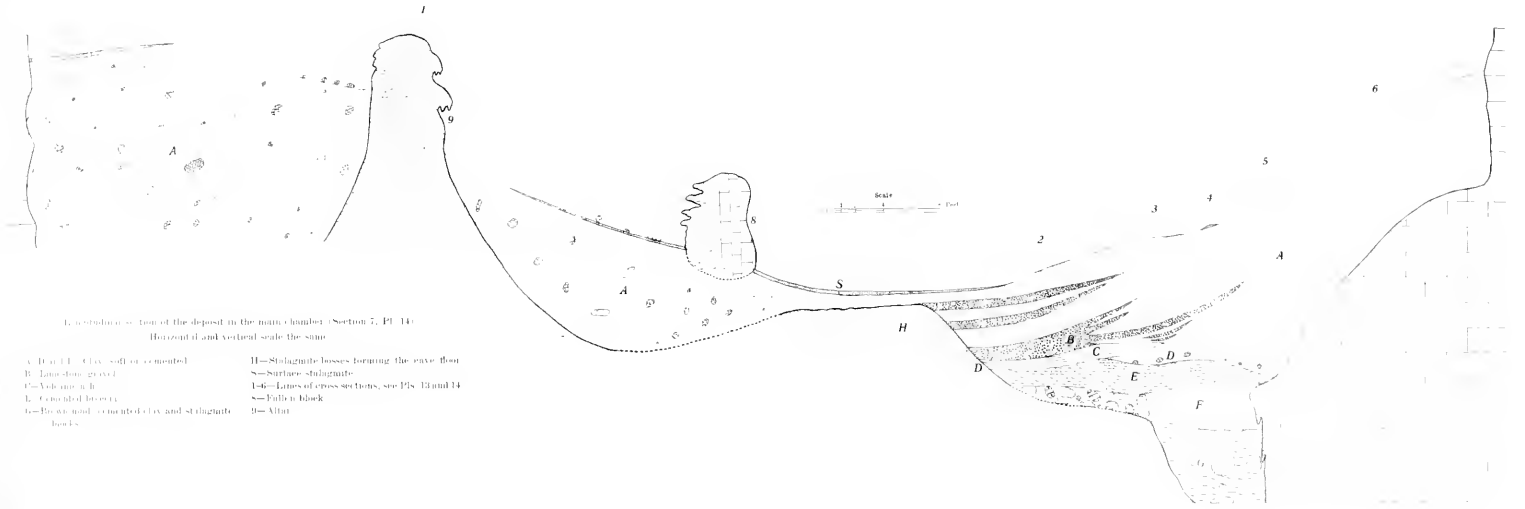
Contour interval 6 inches

Levels are run with reference to an arbitrary datum plane, below which depression contours are indicated by a pecked minus sign. The boundaries of rock masses, the cave walls and the lines of sections cut across the outlines. A small grotto at the extreme northwest end is not shown on the map. The position of the entrance to the buried galleries is represented by broken lines.

1–7—Lines of sections; see Pls. 12 and 14 8—Altar

9—Fallen block resting on clay 10, 11—Stalagmite-covered rock benches

12—Stalagmite boss resting on cross-bedded clay



I. A reconstructed section of the deposit in the main chamber (Section 7, Pl. 14).
Horizontal and vertical scale the same.

A, B and E—Clay, soft or cemented
B—Limestone gravel
C—Volcanic ash
E—Cemented breccia
G—Breccia and cemented clay and stalagmite boulders
H—Stalagmite losses forming the eave floor
S—Surface stalagmite
1-6—Lines of cross sections, see Pls. 13 and 14
8—Pallet block
9—Altar

BOTANY.—W. A. Setchell, Editor. Price per volume $3.50. Volume I (pp. 418) completed:

No. 1. A Botanical Survey of San Jacinto Mountain, by Harvey Monroe Hall . . . . . Price, $1.00

No. 2. Two New Ascomycetous Fungi Parasitic on Marine Algæ, by Minnie Reed . . . . . Price, .25

No. 3. Algæ of Northwestern America, by W. A. Setchell and N. L. Gardner. Price, 2.25

GEOLOGY.—Bulletin of the Department of Geology. Andrew C. Lawson, Editor. Price per volume $3.50. Volumes I (pp. 428) and II (pp. 450) completed. Volume III (in progress):

No. 10. Two New Species of Fossil Turtles from Oregon, by O. P. Hay
No. 11. A New Tortoise from the Auriferous Gravels of California, by W. J. Sinclair . . . . . } In one cover. Price, .10

No. 12. New Ichthyosauria from the Upper Triassic of California, by John C. Merriam . . . . . Price, .20

No. 13. Spodumene from San Diego Co., California, by Waldemar T. Schaller . . . . . Price, .10

No. 14. The Pliocene and Quaternary Canidae of the Great Valley of California, by John C. Merriam . . . . . Price, .15

No. 15. The Geomorphogeny of the Upper Kern Basin, by Andrew C. Lawson . . . . . Price, .65

No. 16. A Note on the Fauna of the Lower Miocene in California, by John C. Merriam . . . . . Price, .05

No. 17. The Orbicular Gabbro at Dehesa, San Diego Co., California, by Andrew C. Lawson. . . . . Price, .10

EDUCATION.—Elmer E. Brown, Editor. Price per volume $2.50.

Volume I (pp. 424). Notes on the Development of a Child, by Milicent W. Shinn . . . . . Price, 1.20

Vol. II (in progress).—No. 1. Notes on Children's Drawings, by Elmer E. Brown . . . . . Price, .50

Vol. III (in progress).—No. 1. Origin of American State Universities, by Elmer E. Brown . . . . . Price, .50

No. 2. State Aid to Secondary Schools, by David Rhys Jones . . . . . Price, .75

ZOOLOGY.—W. E. Ritter, Editor. Price per volume $3.50. Volume I (in progress):

No. 1. The Hydroida of the Pacific Coast of North America, by Harry B. Torrey . . . . . Price, 1.00

No. 2. A Case of Physiological Polarization in the Ascidian Heart, by Frank W. Bancroft and C. O. Esterly . . . . Price, .10

No. 3. Embryology and Embryonic Fission in the Genus Crisia, by Alice Robertson . . . . . Price, .50

No. 4. Correlated Protective Devices in Some California Salamanders, by Marian E. Hubbard . . . . . Price, .20

No. 5. Studies on the Ecology, Morphology, and Speciology of the Young of Some Enteropneusta of Western North America, by Wm. E. Ritter and B. M. Davis . . . . . Price, .50

PHYSIOLOGY.—Jacques Loeb, Editor. Price per volume $2.00. Volume I (in progress):

No. 9. On the Production and Suppression of Glycosuria in Rabbits through Electrolytes (a preliminary communication), by Martin H. Fischer.

No. 10. On the Influence of Calcium and Barium on the Flow of Urine (a preliminary communication), by John Bruce MacCallum.

No. 11. Further Experiments on the Fertilization of the Egg of the Sea-urchin with Sperm of Various Species of Starfish and a Holothurian, by Jacques Loeb.

No. 12. On the Production and Suppression of Glycosuria in Rabbits through Electrolytes (second communication), by Martin H. Fischer.

No. 13. The Infuence of Saline Purgatives on Loops of Intestine removed from the Body, by John Bruce MacCallum.

No. 14. The Secretion of Sugar into the Intestine caused by Intravenous Saline Infusions, by John Bruce MacCallum.

(No. 13 and No. 14: In one cover.)

No. 15. On the Influence of the Reaction of the Sea-Water on the Regeneration and Growth of Tubularians, by Jacques Loeb.

PATHOLOGY.—Alonzo E. Taylor, Editor. Price per volume $2.00. Volume I (in progress):

No. 1. On the Quantitative Separation of the Globulins of Hemolytic Serum, with Special Reference to the Carbon Dioxide Group, by Clarence Quinan.

No. 2. Hydrolysis of Protamine with Especial Reference to the Action of Trypsin, by Alonzo Englebert Taylor.

No. 3. On the Synthesis of Fat Through the Reversed Action of a Fat-Splitting Enzyme, by Alonzo Englebert Taylor.

No. 4. On the Occurrence of Amido-Acids in Degenerated Tissues, by Alonzo Englebert Taylor.

(No. 3 and No. 4: In one cover.)

ASTRONOMY.—W. W. Campbell, Editor.

Publications of the Lick Observatory.—Volumes I–V completed. Volume VI (in progress):

No. 1. A Short Method of Determining Orbits from Three Observations, by A. O. Leuschner.

No. 2. Elements of Asteroid 1900 GA, by A. O. Leuschner and Adelaide M. Hobe.

No. 3. Preliminary Elements of Comet 1900 III, by R. H. Curtiss and C. G. Dall.

Contributions from the Lick Observatory.—Nos. I–V.

Lick Observatory Bulletins.—Volume I (pp. 193) completed. Volume II (in progress).

AGRICULTURE.—Bulletins of the Department of Agriculture. Nos. 1–146.

Biennial Reports of the Department of Agriculture.

Publications of this Department are sent *gratis* to citizens of the State of California. For detailed information regarding them address Professor E. W. Hilgard, University of California, Berkeley.

UNIVERSITY CHRONICLE.—An official record of University life, issued quarterly, edited by a committee of the faculty. Price, $1.00 per year. Current volume No. VI.

Address all orders, or requests for information concerning the above publications (except Agricultural) to **The University Press, Berkeley, California.**